A Giant Leap for the Space Geodesy Facility (SGF)

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The NERC SGF team at Herstmonceux in East Sussex regularly makes laser range measurements of mm-level precision to a variety of Earth-orbiting satellites both by day and at night. Such measurements, to both active and inert satellites at heights of from 400 to 20,000km above the Earth, support a large variety of geodetic and geodynamic research both within the UK and as part of the International Laser Ranging Service, a global network of very precise tracking stations. The Facility also operates two geodetic Global Navigational Satellite System (GNSS) receivers that again are part of a large global network, plus an absolute gravimeter that is aiding UK research into subtle regional and local vertical motion signals.

However, during the early morning of Monday 13th July 2009, the SGF laser reached a satellite at over 15-times the distance of the highest satellite ever tracked from Herstmonceux. The satellite in question is the NASA Lunar Reconnaissance Orbiter (LRO), which as its name suggests, is in lunar orbit at a distance from the earth of approximately 300,000km. The laser pulses, emitted at a rate of 14 per second, were directed by the tracking telescope with pin-point accuracy towards the LRO, and the on-board detector recorded their arrival times more than a second after each had been transmitted from Herstmonceux. Comparison of these arrival times with the accurately-measured instances of their transmission will provide distance measurements of the spacecraft to a precision of about 10cm. As a result of this first hour-long observing session the NASA mission managers report that the LRO detector identified 2195 seconds-worth of events (out of a possible 3600), on average a 60% success rate, from the SGF laser. The observer, Matthew Wilkinson, was kept informed of his success in near-realtime via a NASA website that displays the events in graphical form. Matt also took the photograph reproduced below, that shows laser pulses beaming towards the Moon from the SGF telescope. Of course, the LRO is far too faint to be seen against the glare of the Moon, even in the Facility's high-gain cameras. A second opportunity for Herstmonceux two hours later was also successful, but the observer Rob Sherwood had to contend with poor sky conditions and a consequently reduced success rate.

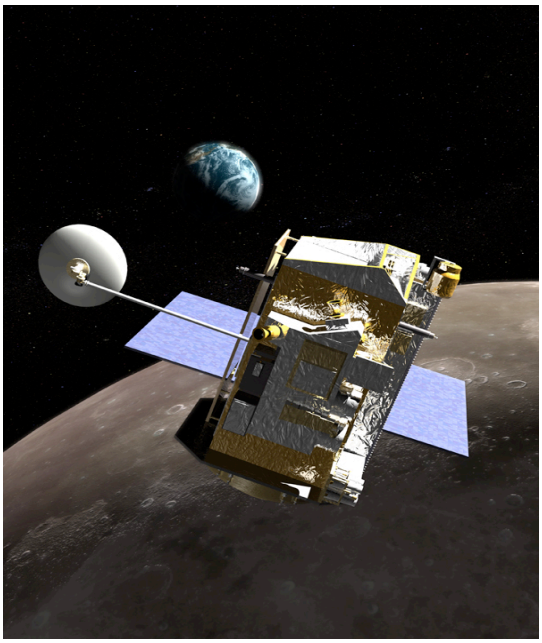
The LRO itself was launched from Cape Canaveral on June 18th 2009 and was a few days later inserted into a commissioning, elliptical orbit that takes it from 30 to 200km above the lunar surface in a period of about two hours. It is the first mission of the NASA Robotic Lunar Exploration Program (RLEP) and its mission objective is to conduct investigations that will be targeted specifically to prepare for and support future human exploration of the Moon. In particular, one-way ranging to the LRO will determine the spacecraft's position at a sub-meter level with respect to the Earth and the centre of the Moon (on the lunar near-side or whenever possible). This aspect of the mission will allow for the determination of a more precise orbit than is possible with the radio, S-band tracking data alone. In turn, the availability of the precise orbit will allow the mission to create accurate maps of the lunar topography from the Lunar Orbiter Laser Altimeter (LOLA) and to make improvements in the knowledge of the complex lunar gravity field.

During these initial test ranging sessions, the NASA mission managers are tasking one laser station at a time to attempt tracking in order to simplify their data analysis and quality check process. The first stations to be so tasked were the NASA-run Next Generation Satellite Laser Ranging system under development at the Goddard Space Flight Centre, Maryland, and the SLR system at the McDonald Observatory in Texas. Incidentally, it is this station that since 1969 continues to make true, two-way laser range measurements to the lunar surface, courtesy of the Apollo astronauts who placed clusters of retro-reflectors on the surface during the manned landings. The SGF system is the first non-US system to be asked to contribute, and of course we are delighted to have been

successful at the first attempt. SGF responded a year ago to a NASA call for participation and recently became a signed-up member of a small group of stations whose flexibility and state-of-the art timing and laser equipment will permit them to make a serious contribution to this exciting year-long mission, coming forty years after the first manned Moon landings.

More details of the LRO-LR mission are available at http://lrolr.gsfc.nasa.gov/index.html ;
more information about the LRO mission itself is available at: http://lro.gsfc.nasa.gov/ ;
the International Laser Ranging Service website is at:
http://ilrs.gsfc.nasa.gov ;
the Space Geodesy Facility website is at: http://sgf.rgo.ac.uk/

Laser pulses from SGF to LRO, 4am Monday 13th July 2009.



Artist's impression of the LRO (NASA)